CHAPTER 3

OPERATIONAL ENVIRONMENT

The operational environment of a force projection army is as varied and complex as the combination of geography, terrain, weather, infrastructures, and threats that exist throughout the world. Motor transport units and soldiers must be versatile enough to cope with, and achieve success in, many different environments and various types of military operations.
Units may have to operate in mountains, jungles, or deserts; in cold, hot, or otherwise inclement weather; in urban or rural areas; on dry, wet, or snowy roads; or on rugged, cross-country terrain. They may be called on to support Army forces during war or during peace enforcement, peacekeeping, or disaster relief operations. This chapter discusses potential threats to motor transport units, operations security and defense, and operations in adverse terrain and climates
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3-1. THREAT. At any time, and on short notice, US forces may be called on to deploy anywhere in the world. As a member of this team, Army motor transport units and soldiers may be faced with a vast number of potential threats. Regardless of the environment or type of operation, they must be prepared to protect themselves and their equipment in base defense, in convoys, and at customer locations. They must be aware of the threat that exists in the area in which they operate.

Many potential adversaries consider logistics units and bases to be prime targets for their deep operations. Probable targets include ports, transfer points, and lines of communication such as roads and inland waterways. These areas are all supported and used by motor transport units. An adversary may employ airborne or airmobile forces, long-range artillery and rockets, and irregular or guerrilla forces. Terrorists may attempt to disrupt activities (even during periods not associated with combat) using ambushes, snipers, raids, or sabotage. These prime targets are also environmentally sensitive, increasing the challenge to protect--not only from operational damage, but from an adversary's ecological attack.

Given this challenging environment, motor transport soldiers must be fit, trained, and ready to respond. Leaders must prepare soldiers to serve in adverse conditions for extended periods by providing appropriate training and leadership skills. Leaders must build units with the courage to overcome odds to accomplish the mission and the determination to provide forward support to sustain combat or other operations. Leaders are also ultimately responsible for preparing their units and soldiers to survive in today's NBC environment.

3-2. OPERATIONS SECURITY. Operations security is an integral part of planning for operations, unit training, and day-to-day operations at all levels of command. Throughout the planning, preparation, and execution phases of an operation, every effort must be made to maintain security. Security measures should also be included in unit training programs. Unit S3s develop OPSEC protective measures. There are four steps in the OPSEC planning sequence:

- Determine enemy capabilities for obtaining information about motor transport operations.
- Determine what information obtained by the enemy can compromise the operation.

- Determine which actions taken by motor transport units before an operation, if known and analyzed by the enemy, would give the enemy the information he needs.
- Determine what protective measures are necessary and where they must be implemented to maximize operations security.

Operations security measures include:

- Countersurveillance.
- Signal security.
- Physical security.
- Information security.

a. **Countersurveillance**. Countersurveillance includes all active or passive measures taken to prevent threat forces from seeing your area, equipment, movements, and so forth. Countersurveillance techniques include--

- Camouflaging and toning down trucks, including the headlights and windshields, when they are not moving.
- Moving at night or during periods of reduced visibility using blackout lights.
- Using terrain as concealment.
- Maintaining noise, litter, and light discipline.

b. **Signal Security**. Signal security is the use of communications and electronics security techniques to prevent the disclosure of operational information. It includes the use of communications codes, secure voice equipment, and proper positioning of antennas. Techniques for motor transport units include--

- Keeping radio transmissions short.
- Maintaining signal silence whenever possible.
- Using wire communications when possible.
- Using low power in radios.

c. **Physical Security**. Physical security is the use of security forces, barriers, dispersal, concealment, and camouflage to deny enemy access to facilities, areas, equipment, materiel, and personnel. Physical security protects operational information or activities. Some practical techniques include--

- Employing security elements to the front and rear and, when required, to the flanks of convoys.
- Using listening and observation posts when in garrison and operations areas.
- Identifying avenues of approach and covering them with fields of fire.
- Employing obstacles that impede the enemy.
- Using challenge and passwords.
- Using early warning devices.

d. **Information Security**. Information security is the control of written, verbal, and graphic information to prevent the disclosure of operational information. To ensure information security--

- Never post information out in the open, such as on a vehicle windshield.
- Do not allow local civilians without clearances into work and assembly areas.
- Handle all classified and sensitive documents properly.

3-3. SECURITY AND DEFENSE PLANS. The motor transport commander must know what defensive measures are to be taken during ground, air, airborne/heliborne, guerrilla, and NBC attacks while conducting motor transport operations. The commander ensures that personnel are assigned specific duties with respect to security defense measures and makes sure they are familiar with these duties. The commander has his staff survey operations and make plans to lessen the possibility and effects of an attack. The staff uses all means available to include the OPSEC planning steps and the inclusion of OPSEC measures into operational plans and SOPs. Security and defense plans must be flexible. Operational commitments will reduce the number of personnel available for security and defense. Therefore, the plan should include support available from other sources (such as adjacent units and area support groups). The plan should be simple. Generally, the commander's main concern is defense against aircraft, airborne/ heliborne, guerrilla, nuclear, or chemical attacks. Ground attacks are of primary concern.

3-4. MOTOR TRANSPORT OPERATIONS UNDER ADVERSE TERRAIN CONDITIONS. Terrain creates the most common barriers affecting motor movement. Prepare for terrain obstacles through map studies and route reconnaissance. Adjust speeds and restrict vehicle loads as needed.

Standard military vehicles are designed and manufactured to lessen the effects of difficult terrain. Planners and operating personnel must recognize and make allowances for the limitations that the terrain imposes. Drivers should be trained on a variety of terrain to build confidence. This will enable them to negotiate natural or manmade obstacles with minimum delays. See Appendix F for hints for vehicle operations in difficult terrain.

a. **Hilly or Mountainous Terrain**. Plans for motor movements in hilly or mountainous regions must be based on a knowledge of current conditions of the area. Rugged terrain increases the need for specific information regarding grades, road characteristics, and bridge capacities. Available maps and information from reconnaissance and intelligence will indicate the type and maximum number of vehicles that can profitably be employed in any particular operation. In some cases, engineer assistance may be required to reinforce bridges and culverts and to maintain road surface during continued movement. On steep grades, normal loads may have to be drastically reduced to keep traffic moving at a reasonable rate. Many of the heavier vehicles with little off-road capability may be useless in bad conditions. Successful motor movement depends on--

- Selecting appropriate vehicles.
- Adequately training drivers.
- Knowing transport capability.

(1) ***Maintenance***. Maintenance, particularly operator maintenance, is of major importance in motor movement in mountainous terrain. Before and during operations in the

mountains, the safety devices of all vehicles must be thoroughly checked. On-the-spot adjustments must be made to ensure proper operation. Mechanical failures that might be considered of minor importance in other situations may cause serious accidents on steep grades and sharp curves. Proper inspection of the brake linkage and proper adjustment of brakes are critical. The emergency brake must be able to limit speed when descending steep slopes. The transmission must be properly maintained and in good operating condition.

(2) ***Planning considerations***. Steep grades are prevalent in mountainous terrain. The proper selection of vehicles for an operation will enable continued movement without resorting to winching. Drivers must be extremely careful at all times because of sharp, blind curves and dangerous grades. Either uphill or downhill grades should be taken in a gear ratio that will enable the vehicle to take the entire hill without shifting. When entering a short, steep grade, the driver may build up momentum on the approach so that this added momentum will carry him over; or, he may drop into a lower gear to allow for a long steady pull with maximum traction. Use caution to ensure that the speed of the vehicle does not exceed the speed (listed on the chart in the cab of the vehicle) for that particular gear ratio.

WARNING

All curves must be taken at a speed that enables the driver to stop the vehicle in half the road space visible to him.

During daylight operations, all vehicles will normally be in open column. Here, guard against bunching on the approaches to grades and curves. This is important because slow movement of columns in mountainous areas makes vehicles extremely vulnerable to enemy attack.

Blackout driving in mountains will often exceed the danger of enemy action. Therefore, driving without lights on narrow, winding mountainous roads should be held to a minimum. Blackout driving should be limited to those stretches of road subject to enemy observation. At these points, post signs and guides to give special instructions to each driver as he approaches. Trucks should be close-column for blackout operations. Descend hills with a combination of braking and engine power; neither should be used alone to bring a vehicle downhill.

b. **Swampy Ground and Water Obstacles**. Evidence of ground water (the presence of springs, pools, or characteristic plant growth) along a planned cross-country route presents a problem in the movement of wheeled vehicles. Swampy ground and water obstacles are generally associated with valleys or lowlands. However, sidehill bogs and ridgeline swamps may appear where ground water emerges. For planning and operational purposes, consider these barriers to be all-seasonal, although seasonal conditions will affect them as the water table is raised or lowered. Timely estimation of the size and characteristics of obstacles through map study, reconnaissance, and intelligence will aid in determining the--

- Amount and type of added equipment needed to effect the passage of a column.
- Probable delays and adjustments in the schedule to avoid congestion.
- Advisability of using an alternate route to bypass the obstacle.

(1) ***Mud and swamps***. Swamps, bogs, and mud caused by the nearness of the water table to the top of the ground should be avoided by all traffic, if possible. The surface crust may appear dry and well covered with vegetation, but any breakthrough may result in the vehicle becoming hopelessly stuck. The depth of soft mud below the surface is extremely difficult to determine. The depth may vary in the same swamp from between 1 to 2 feet.

When it is necessary to cross such barriers, make provisions to bridge the surface by suitable reinforcement with mats, brush, or special flotation materials. By increasing flotation in this way and by avoiding concentrated loads, traffic may cross otherwise impassable barriers without undue loss or delay. If support of a tactical operation requires movement over large areas of marsh or swampland, help from engineer personnel and equipment must be available. Vehicles with maximum flotation must be selected.

(2) ***Ditches and streams***. Drainage ditches and canals, gullies and ravines, and streams and rivers present obstacles to motor movement--especially if the obstacle is large and if the movement is open to enemy action. Map study, reconnaissance, and intelligence reports may supply all information necessary to planning personnel.

When there is doubt about the ease of crossing an obstacle, request an engineer reconnaissance. The engineers can determine what must be done to make the crossing. Small ditches, gullies, and streams will not cause serious delays, but, even here, approach and passage at reduced speeds require traffic control to avoid congestion. Canals, ravines, and rivers present serious obstacles to motor movement and require definite means for crossing.

Existing bridges and fords offer profitable targets for enemy artillery, bombing, sabotage, and guerrilla activities. Therefore, no movement should be made without a provision for changes in plans demanded by current intelligence.

Techniques of crossing, capabilities of vehicles, and requirements for the construction of temporary bridges or crossing expedients are covered in appropriate FMs and TMs. In general, the existence of canals, ravines, and rivers that cross a selected route requires added preparation by planners. Planners do this to--

- Avoid congestion in critical areas.
- Arrange for repair or construction at crossing sites.
- Furnish adequate instructions to operating personnel to ensure proper conduct of the operation.

See FM 20-22 for detailed information on vehicle recovery operations.

3-5. MOTOR TRANSPORT OPERATIONS UNDER ADVERSE CLIMATIC CONDITIONS. Adverse climatic conditions impose a variety of limitations and challenges on motor transport operations. The effects on personnel and equipment, as well as on methods of movement and maintenance, should be emphasized when planning and executing operations in areas where extreme conditions are the rule. See Appendix G for more guidance on vehicle operations in adverse weather.

a. **Desert Operations**. Desert environments occupy approximately one-fifth of the total land area of the earth. Their climate and terrain justify careful examination of the limitations imposed on military movement. Capabilities can be improved through training personnel and modifying equipment. Broad generalities must be avoided in describing desert environments. Wide variations occur with changing desert forms in the same general area. There are, however, some characteristics common to most. For example, most deserts have--

- Low rainfall creating a scarcity or total lack of water.
- Extensive barren areas of gravel or sand.
- A high sunshine percentage, exceeding 70 percent.
- Extreme daily temperature ranges, with low relative humidity during the day.
- Strong seasonal winds, with periodic sand and dust storms.
- A lack of vegetation, except for scattered scrubby bushes with small leaves and thorns.

Desert land forms are variable. They include sand dunes, rocky hills, steep cliffs, and broad level valleys covered with gravel or stones. They include areas of clay that may become impassable in rainy periods and gullies and dry stream beds that can suddenly become raging torrents.

Desert conditions reduce efficiency of personnel. They increase problems of maintenance of equipment and reduce mobility. They also cause tactical insecurity due to lack of cover and concealment. Successful motor movement in deserts requires added training and conditioning of personnel. It also requires specific adaptation of vehicles and modification of maintenance procedures. Combinations of terrain and climate vary greatly among the world's deserts. Therefore, general operational precautions and techniques must be modified to apply to any specific area. The information that follows may be used as a guide.

(1) ***Driving***. Due to the general absence of established roads in desert areas, desert driving calls for experience, individual skill, and physical endurance of the vehicle operator. Driver training should include as much off-road operation and night operation as possible. Driver training should be carried out under a variety of conditions similar to those found in a desert. This training should include orientation on land forms, soil, and climate using photographs, films, and discussions.

Driving in sand requires judgment in selecting proper gear ratios, determining suitable speeds, and choosing the best ground. The driver must recognize the limitations of his equipment, particularly the tendency of wheeled vehicles to dig in when forward momentum is lost. He must be able to employ proper recovery expedients immediately. Provisions should be made for added equipment on the vehicles or within a column. Added equipment will be needed for the rapid recovery of stuck vehicles.

Unit SOPs should be modified for desert operations. The SOP should include procedures necessary to keep the column moving without unnecessary congestion around a disabled or immobilized vehicle.

Driving in other desert land forms requires the application of a variety of driving principles. Driving in deserts demands sound judgment and experience on the part of both vehicle operators

and command personnel. No simple formula or means of testing to determine soil trafficability in the desert has been developed. Therefore, each new situation must be evaluated in light of experience. In most desert areas, sand is the common obstacle.

(2) ***Maintenance***. Vehicular maintenance presents a major problem in all desert operations. Under the best conditions, movement of vehicles over desert terrain creates a great volume of dust. The dust factor alone demands constant unit-level maintenance to prevent abnormal wear and inoperable vehicles. Drivers must daily check and clean air filters (more often under extremely dusty conditions), check oil filters, and inspect steering knuckle boots for damage. Vehicle instruments should be sealed (using tape or sealing compound) to keep out dust. When servicing vehicles, care must be taken to ensure that no sand gets into fuel tanks and crankcases. Even with the best maintenance possible, wear will be greater in desert operations than in normal operations.

Excessive heat also creates maintenance problems. Overheating of vehicles, through long periods of operation in low gear and the rapid evaporation of coolants, requires more frequent rest periods to prevent or reduce engine damage. During these rest periods, vehicles should be faced into the wind to cool. During stops, be sure to inspect regularly the following--

- Fan belts, replacing immediately when excessive wear is noted.
- Radiators, to ensure free circulation of air and coolant.
- Batteries (daily), to maintain the proper level of electrolyte (water).

The combination of heat, sand, and rough ground in desert areas causes excessive wear to tires. The following guidelines will help drivers to maximize tire mileage:

- Maintain proper tire pressure to guard against rim slippage and broken tire fabric.
- With dual-wheeled vehicles, frequently inspect for stones wedged between the tires and remove them before damage is done to the side walls.
- When halted overnight or for any extended period, the rears of vehicles should be parked into the wind.
- Conduct night operations when possible to prolong tire life.

(3) ***March techniques***. Motor movement operational techniques must be modified for desert operations. The desert usually has no well-defined roads or trails. Therefore, normal methods of assigning routes, direction by signs and guides, and movement control do not work. Movement from place to place is usually made using navigational methods and equipment. Take care to maintain sufficient dispersion to prevent presenting favorable targets to the enemy. Deserts generally offer little or no natural concealment from aerial observation. However, unevenness in terrain may afford cover and concealment from direct ground observation. Camouflage nets and shadows in broken ground areas must be used to give some measure of security.

(4) ***Planning considerations***. Movement planning for desert operations involves looking at the influence of climate and terrain on movement. Planning personnel at all levels must be familiar with the capabilities and limitations of both personnel and equipment. Make necessary changes to the organization, training, and equipment as early as possible. Select vehicles most

suitable for the local climate and terrain. This will ensure maximum mobility and will lessen excessive supply and evacuation requirements of the vehicles themselves. Selecting and/or training operational personnel is a major factor in planning. The physical and psychological effects of climate reduce personnel efficiency; at the same time, operational and maintenance demands are at peak levels. Selection of personnel should include only those best qualified physically and mentally to endure hardship.

Motor movement in desert areas is also made difficult by terrain and the tactical situation. Dispersion is increased to achieve some degree of tactical security. This increases the time length of convoys. Also, the experience with time and space schedules developed in other terrains will not be very helpful. Routing must be general rather than specific. This is because point-to-point distances may be materially increased by local nontrafficability. Column control is another problem. Column control will normally be exercised from within the column by radio or visual signals. Supply and evacuation movements in the desert usually involve greater distances. This is because of the dispersion of installations and the greater volume of supplies/support required in desert operations.

Training should stress leadership, physical conditioning, operation of vehicles in desert environment, and principles of land navigation. See FM 21-305 for details on desert driving.

b. **Jungle and Forest Operations**. Jungle and forest conditions vary from the heavily forested areas of the North Temperate Zone to the impenetrable equatorial rain forests. Whatever the location, jungles and forests affect motor movements. Heavy annual rainfall, high relative humidity, and adequate soil fertility are characteristic of all such areas. In Temperate Zones, the forests have many large trees but little undergrowth. Northern forests limit cross-country motor operations, but the overhead cover they offer conceals military activity and equipment. On the other hand, equatorial rain forests present a definite obstacle to all military operations. All mobility, even for personnel traveling on foot, is hampered by a tangle of dense undergrowth that must be cleared to allow passage. Roads must be constantly maintained and are usually limited to unimproved trails.

Military motor movements in all heavily forested areas are open to enemy ambush and delay. Motor movements in areas of heavy vegetation are difficult. Again, climate and terrain are critical factors. Climatic factors include the type of vegetation in the area and its effect on movement. Also significant are the effects of climate on maintenance and human efficiency as well as the tactical effects of these conditions. Density of vegetation affects vehicle movement. Although roads and trails may be adequate for the movements planned, some off-road movement may be forced by enemy actions. Therefore, the movement organization should include the personnel and equipment necessary to ensure continued movement. Personnel must be capable of providing emergency bypasses, making highway repairs, or reducing roadblocks. Continued use of routes through these areas may require engineer road maintenance patrols to keep them open for wheeled traffic. Except in equatorial rain forests, tracked vehicles have sufficient off-road mobility to bypass damaged sections of road. However, compared to wheeled vehicles, tracked vehicles are limited in speed and cargo capacity and are less economical to operate.

(1) ***Driving***. March control must be modified for jungle or forest operations. March units should usually move as compactly as possible to ease control, improve security measures, and aid rapid movement. Close column formations permit easier following of trail; however, in tactical situations, such formations increase the danger of ambush. Open columns and

infiltration moves lessen the danger of a general ambush. However, the possibility for a small element or single vehicle being separated and ambushed is increased.
Base the desired formation on a careful evaluation of existing conditions. Always maintain close liaison between elements of the march. Avoid complete dependence on radio communication. Normal radio operating ranges are greatly reduced by dense vegetation and adverse operating conditions. In preparing movement orders or SOPs, be sure to arrange for alternate means of communication.

Reconnaissance must be provided both in advance of and during the movement. This is done to ensure adequate information on the selected route, provision of alternate routes, and timely warning of possible enemy interference. Reconnaissance units operating in these areas must be particularly well trained and alert. Maintain march discipline at all times and furnish adequate security at halts.

Aerial observation of ground movement is seriously restricted by overhead cover. By careful use of this overhead screen, large groups of vehicles may move or bivouac without danger of detection or attack from the air. Prescribed distances should be maintained at the cost of reduced speed.

(2) ***Maintenance***. Motor maintenance is increased in jungles because of the added strains of operating on unimproved roads, long periods of operation in lower gears, and rust and corrosion caused by high humidity. Human efficiency drops sharply in tropical areas of high humidity, and efficient maintenance becomes extremely difficult.

(3) ***Planning considerations***. Planning for movements in jungle or heavily forested areas requires early consideration of climate and terrain. Anticipate the need for added personnel and equipment to give timely support to movements. Distances involved may be comparatively short, but road speeds will usually be reduced. Allowances must also be made for route construction and maintenance. Supply and evacuation in jungle operations should be closely coordinated. The key is to make maximum use of trucks and to reduce traffic. Tropical conditions require increased protection for supplies against the effects of rain, high humidity, and heat from sunshine.

c. **Operations in Snow, Ice, and Extreme Cold**. Operations conducted in snow, ice, and extreme cold may be divided into two general categories:

- Arctic and subarctic operations.
- Winter operations in the North Temperate Zone.

Operations in the arctic and subarctic mainly involve the effects of low temperatures. Low temperatures recorded in this area are constant during the winter months and continue for long periods. See FMs 31-70, 31-71, and 90-6 for current doctrine on arctic and subarctic operations.

The secondary category, winter operations in the North Temperate Zone, directly affects the movement of most land armies. The North Temperate Zone includes a large portion of the civilized world. A knowledge of expected winter conditions and their influence on military operations is essential to the success of winter campaigns. In the North Temperate Zone, snow, ice, and extreme cold may restrict some movements while favoring others. Motor movement on highways is definitely restricted by heavy snowfalls or ice. In many cases, special equipment is

necessary to make any movement possible. In all cases, highway speeds will be reduced. On the other hand, cross-country movement may be facilitated by the presence of deep frost. In the North Temperate Zone, snowfalls of over 2 feet are common. Sleet storms can glaze highways with clear ice in a matter of hours, and temperatures to -40° F may be encountered.

All of these conditions demand organizational and individual operational modifications. Motor columns must travel at reduced speeds. They must be prepared to encounter sudden changes in highway trafficability. Accidents caused by road conditions may be common until drivers gain experience. However, providing emergency vehicles within the column will reduce delays. Personnel and equipment for snow removal or sanding will seldom be available except on regularly traveled routes.

Instruct all drivers to use extreme caution at all times. Drivers must put on tire chains when in doubt. They must test the traction of their vehicles while on the march. Temperature affects traction more than any other weather element. Traction for wheeled vehicles on snow and ice without the use of chains is improved by subzero temperatures. However, the presence of a light, dusting snow over glazed ice is extremely treacherous. In cases where moisture is present on the tires, chains should be used. Until better classification methods evolve to indicate snow trafficability, the judgment and experience of the driver must suffice. The driver must master techniques of smooth, gradual acceleration and deceleration. Sudden starts and stops will result in complete loss of traction.

In such conditions, the interval between vehicles should be greater than normal. Drivers should be instructed to maintain prescribed intervals since stopping distances are greatly increased.

(1) ***Maintenance***. In cold climates and during the winter months, motor maintenance becomes increasingly important and more difficult. Automotive equipment must be maintained in top mechanical condition to run efficiently in subzero weather. The conditions under which this maintenance must be performed are usually unfavorable. Seasonable preparation for cold weather is the most effective means of preventive maintenance. Inspect and winterize all vehicles before freezing temperatures are expected. Winterization includes--

- *Lubrication*. Lubricate vehicles thoroughly, using proper oil and grease for the expected temperatures as indicated in lubrication orders.
- *Ignition*. Clean spark plugs and adjust gaps. Check coil, generator, starter, voltage regulator, and distributor.
- *Battery*. Test cells, check electrolyte, clean terminals, and tighten cables and clamps. Battery efficiency drops in extreme cold when the heaviest output loads are required.
- *Cooling system*. Carefully inspect the cooling system for leaks, tighten connections, and replace worn hoses. Check the water pump, thermostat, and fan belt for proper operation. Drain and thoroughly flush the system and refill with the indicated solution of antifreeze.
- *Fuel system*. Check for fuel leaks and replace parts if necessary. Adjust the carburetor for cold weather operation. Check intakes and manifold gaskets. When extreme cold is expected, drain fuel tank sump to remove any water that may have accumulated and refill. Add 1 pint of Grade III denatured alcohol to every 10 gallons of gas to prevent freezing of fuel lines.
- *Brakes*. Check brake adjustment, fluid, linings, and connections.

- *Exhaust*. Check exhaust system for leaks. Carbon monoxide from a leaky exhaust system is deadly in a closed cab.
- *Vision*. Check lights, windshield wipers, mirrors, and defrosters.
- *Tire chains*. Make sure that tire chains are present, are the proper size, and are in good repair.

Driver duties and responsibilities in preventive maintenance are increased during cold weather operations. Each driver must be told that his comfort, safety, and perhaps his life, depend on preventive maintenance. Besides the normal before-, during-, and after-operation preventive maintenance, the driver must be careful to warm up his engine gradually before loading. He must be sure that the winterization of his vehicle is adequate and that it stays that way. He must know and apply the measures necessary to give him adequate vision in all kinds of winter weather. He must also be able to recognize the early symptoms of ignition failure or battery failure and take appropriate corrective action. Command supervision of maintenance activities in all categories is particularly important when heated facilities are inadequate or not available. Many times, only those items considered most important will receive attention from personnel whose discomfort is their major concern.

(2) ***Planning considerations***. The successful planning and conduct of winter motor movements in the North Temperate Zone is based on thorough familiarity with local weather and terrain. Movement plans must take into account maximum severity of weather for the season and be flexible to allow for sudden changes. A sudden rise in temperature accompanied by a warm rain will turn trafficable snow into mud and slush. Temperatures, while above freezing, will cause great discomfort to personnel. Midwinter thaws are followed just as suddenly by subzero temperatures, causing the freezing of deep ruts and dangerous ice. The accumulation of frozen slush on running gears and the undercarriage of a vehicle may cause failure of components. Accumulation may also become of such a size as to bind moving parts and/or wheels and lead to accidents. Sudden changes in weather will often have a bad effect on motor transport operations. Advance planning and preparation must include--

- Winterizing vehicles to meet the most severe weather.
- Instructing operating personnel in winter hygiene and first aid.
- Issuing suitable cold weather clothing and equipment.
- Requesting engineer personnel and equipment as indicated to expedite movement.

Route selection should be based on data resulting from a route and area reconnaissance. Alternate routes should be used to take advantage of changes in trafficability due to weather. In spite of reduced speeds, column formations will normally be open due to the intervals required for increased stopping distances. During periods of low visibility, columns will close up to maintain control. Schedule frequent halts to allow drivers to rest and personnel to move about to improve circulation.

3-6. THE HIGHWAY NET. When selecting routes over which cargo is to be hauled, consider the capabilities of the roads and bridges to sustain the operation. For example, the gross weight of the heaviest loaded vehicle should not exceed the rated tonnage capacity of the weakest bridge. See Appendix H for information on evaluating a highway net.